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tific value of the Yellowstone Park. At the same time, I am confident that I have in no degree over-estimated its value to science, but, on the contrary, I have been obliged to omit mention altogether of many points which might add greatly to the interest in this section of country, for lack of space to record them.

If anything which I may have said shall in any way aid in developing an interest in our park, or in any of the special departments of science which can there be best prosecuted with success, I shall be well repaid for my effort.

It must be remembered, however, that at present everything in this region is in a crude state, and it will be necessary to introduce gradually the requisite appliances for work, and means for the accommodation, transportation and sustenance of those who desire to work in this field. These will all come in due time, as the avarice of man leads him to discover these demands for his commodities, and in the meantime we may congratulate ourselves that the work of *destruction* is stayed.

I do not propose here to offer any suggestions nor to put forward any plans for the furtherance of scientific investigation; my purpose is accomplished if I have succeeded in making a lucid statement of the real facts of the case. In an article to appear in the succeeding number of the *NATURALIST*, it is my intention to enter more fully into the subject of the best methods for the improvement of this tract.

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## ON THE STRUCTURE AND AFFINITIES OF THE BRONTOTHERIDÆ.\*

PLATES I, II.

BY PROFESSOR O. C. MARSH.

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THE Miocene deposits on the eastern slope of the Rocky Mountains contain the remains of a group of gigantic mammals, of much interest, which have been named by the writer, *Brontotheridæ*.† Although these animals are less remarkable than the

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\* Published in part in the Amer. Jour. of Sci., vol. vii, Jan., 1874.

† Amer. Jour. Sci., vol. v, p. 486, June, 1873.

*Dinocerata* of the Eocene,\* which they seem to have replaced, they equalled them in size, and resembled them in several important features, notably in the structure of the feet, and in having the head armed with a pair of powerful horns. The general structure of the group, however, clearly indicates that they do not belong in the order *Dinocerata*, but should be placed with the Perissodactyls, in which they form a well-marked family.

The more prominent characters of this family were pointed out by the writer in describing *Brontotherium gigas* Marsh, the type species, and others had been previously mentioned by Dr. Leidy, in his descriptions of *Titanotherium Proutii*.† The skull of the latter genus is not known, but there can now be no reasonable doubt that it was furnished with horns, in some respects similar to those of *Brontotherium* (plates i and ii). The possibility of this was originally suggested by Dr. Leidy,‡ and in his latest work he has figured a horn-core from the same deposits which yielded the *Titanotherium* remains.§ The fragmentary specimen described by Dr. Leidy as *Megacerops Coloradensis*|| probably belongs in the same family, but until additional remains are found this point cannot be decided. The supposed genera *Symborodon* and *Miobasileus*, recently indicated by Prof. Cope (vii, p. 723), belong to this group. The former is generically identical with *Brontotherium*, the reputed absence of lower incisors being evidently due, as shown below, either to age, or to imperfect specimens. *Miobasileus* is apparently the same genus, and hence both names should be regarded as synonyms of *Brontotherium*.

Among the more marked characters of the *Brontotheridæ*, which readily distinguish them from the *Rhinocerotidæ*, apparently their near allies, may be mentioned the following:—There are four short and thick toes in the manus, and three in the pes. The skull supports a pair of large horn-cores, placed transversely, as in modern Artiodactyls.¶ There are well developed canine teeth in both jaws. The molar teeth, above and below, are not of the *Rhinoceros* type, but resemble those of *Chalicotherium*.

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\* AMER. NAT., vol. vii, p. 146, March, 1873.

† Extinct Mammalia, p. 206, 1869.

‡ Loc. cit. p. 216.

§ Extinct Vertebrate Fauna, pl. xxviii, fig. 3, 1873.

¶ Proceedings Phil. Acad., 1870, p. i, and Extinct Vertebrate Fauna, p. 239.

¶¶ *Rhinoceros pleuroceros* Duv., from the Miocene of France, has a transverse pair of small horn-cores on the nasals, not unlike those in *Dinoceras*. *R. minutus* Cuv. has somewhat similar processes.

The general characters of the *Brontotheridæ* are fully shown in a large series of specimens in the Yale College Museum. The cranial structure of *Brontotherium*, the type genus, is well illustrated in the nearly perfect skull of *B. ingens* Marsh, figured in plates i and ii. The only other genus of the group known with certainty is *Titanotherium* of Leidy (*Menodus* Pomel) which, according to the descriptions of that author, differed essentially in having four lower premolars, and in the absence of a third trochanter on the femur. Less important differences are seen in the composition of the teeth, and in the diastema between the upper canine and first premolar.

The skull in *Brontotherium* is elongated, and resembles in its general features that of *Rhinoceros*. The occipital region is greatly elevated, and deeply concave posteriorly. The brain cavity is unusually contracted. The top of the skull is concave longitudinally, and convex transversely (plates i and ii). The zygomatic arches are massive, and much expanded. The orbit is small, and continuous with the elongated temporal fossa. The nasal bones are greatly developed, and firmly coössified. They support entirely, or nearly so, the large divergent horn-cores. Their anterior extremities are produced, and overhang the large nasal orifice. The premaxillaries are diminutive, and do not extend forward beyond the end of the nasals. The palate is deeply arched above, especially between the premolars. The posterior nares extend forward nearly to the front of the last molar. The lachrymal forms the anterior margin of the orbit. The malar extends forward beyond the lower margin of the orbit. The infra-orbital foramen is very large, and situated well forward. The zygomatic process of the squamosal is elevated, and incurved above. There is a massive post-glenoid process, and a large and somewhat shorter paroccipital process (plate i). The post-tympanic process of the squamosal is large, and quite external to the paroccipital process. The occipital condyles are very large, and well separated.

The mandible has a wide condyle, and a slender coronoid process. The angle is rounded, and slightly produced downward. The symphysis is depressed, elongated, very shallow in front, and completely ossified.

The dental formula of *Brontotherium* is as follows:—

Incisors,  $\frac{2}{2}$ ; canines,  $\frac{1}{1}$ ; premolars,  $\frac{4}{3}$ ; molars,  $\frac{3}{3} \times 2 = 38$ . The upper incisors are quite small. The canine is short and stout,

and placed near the first premolar. The latter is proportionally much larger than the corresponding tooth in *Titanotherium*. The upper premolars have all essentially the same structure, viz: two external connate cusps, with their outer faces nearly plane, and two inner cones closely united. The anterior cone is connected with the opposite outer cusp by a transverse ridge, which has behind it an elongated depression, more or less divided by projections from the outer posterior cusp. In the upper true molars, the external cusps have their outer surfaces deeply concave, while the inner cones are low and separate. The lower incisors were small, and evidently of little use. The two next the symphysis were separated from each other. One specimen in the Yale Museum has the crown hemispherical in form. The lower incisors are frequently wanting, and in old animals the alveoli may, perhaps, disappear. Careful examination, however, will usually show indications of them. The lower canine is of moderate size, and separated from the premolars by a short diastema. The lower molars are of the *Palæotherium* type, and agree essentially with those of *Titanotherium*.

The head in *Brontotherium* was declined when in its natural position. The neck was stout, and of moderate length. The cervical and most of the dorsal vertebræ are distinctly opisthocœlous. The atlas is large, and much expanded transversely. The axis is massive, and has its anterior articular faces much broader than in the *Dinocerata*. The odontoid process was stout, and conical. The transverse process was small, and apparently imperforate. The posterior articular face is concave, and oblique. The epiphyses of the vertebræ are loosely united in most specimens, as in the Proboscidiæ. The caudal vertebræ preserved indicate a long and slender tail.

The limbs of the *Brontotheridæ* were intermediate in proportion between those of the elephant and the rhinoceros. The humerus is stout, and its entire distal end is occupied by the articulation. The olecranon cavity is shallow, and the condylar ridge similar to that of the elephant, but not continued so far up the shaft. The ulna has its olecranon portion much compressed. Its distal end is much smaller than in *Rhinoceros*, and has no articular face for the lunar. The radius is stout, and its distal end expanded. The carpal bones form interlocking series. They are shorter than in *Rhinoceros*, and support four well developed toes of nearly equal

size. The metacarpal bones are shorter than those of the *Rhinoceros*, the first phalanges longer, and the second series shorter. The ungual phalanges are short and tubercular, as in the elephant.

The femur has a small third trochanter, and its head a deep pit for the round ligament. At the distal end, the anterior articular surface is narrow, and the two edges are of nearly equal prominence, as in the tapir. There is a small fossa on the posterior side above the outer condyle. The tibia is stout, and has a distinct spine. The fibula is entire, but quite slender. The astragalus is shorter than in the rhinoceros, and the superior groove more oblique. The cuboid face is larger than in *Rhinoceros*. The navicular has its distal facets subequal. There were three toes of nearly equal size in the pes, the first and fifth being entirely wanting.

The largest known species of this group is *Brontotherium ingens* Marsh, which is represented in the Yale College Museum by a skull, nearly perfect, and other characteristic remains. The specimens preserved indicate that the animals to which they pertained nearly or quite equalled the elephant in bulk, and far exceeded in size any known Perissodactyls living or fossil.

The skull in the type specimen of the species is well represented in the accompanying plates, and its general characters have already been given. It is three feet in length, and twenty-two inches across the zygomatic arches. The most striking peculiarity of this cranium is the pair of huge horn-cores on the nasals. They are about eight inches in length, and extend upward and outward. They are triangular at the base, with the broadest face external. The two inner faces of each core are separated by a ridge, which is continued to the median line. The upper part of the horn-cores is rugose, and the base contains large air cavities. The free extremities of the nasals are coössified, and much elongated. They are rounded in front, slightly decurved, and the surface at the end is rugose. The orbit is of moderate size, and looks forward, outward and upward. The lachrymal foramen is small, and ovate in outline. The infra-orbital foramen is unusually large. There is no post-orbital process. The zygomatic arches are massive, and the squamosal portion widely expanded. The temporal fossa extends far backward, and has over its posterior portion an obtuse ridge. The occipital condyles are very large, wide apart, and extend slightly behind the supra-occipital crest. The paroc-

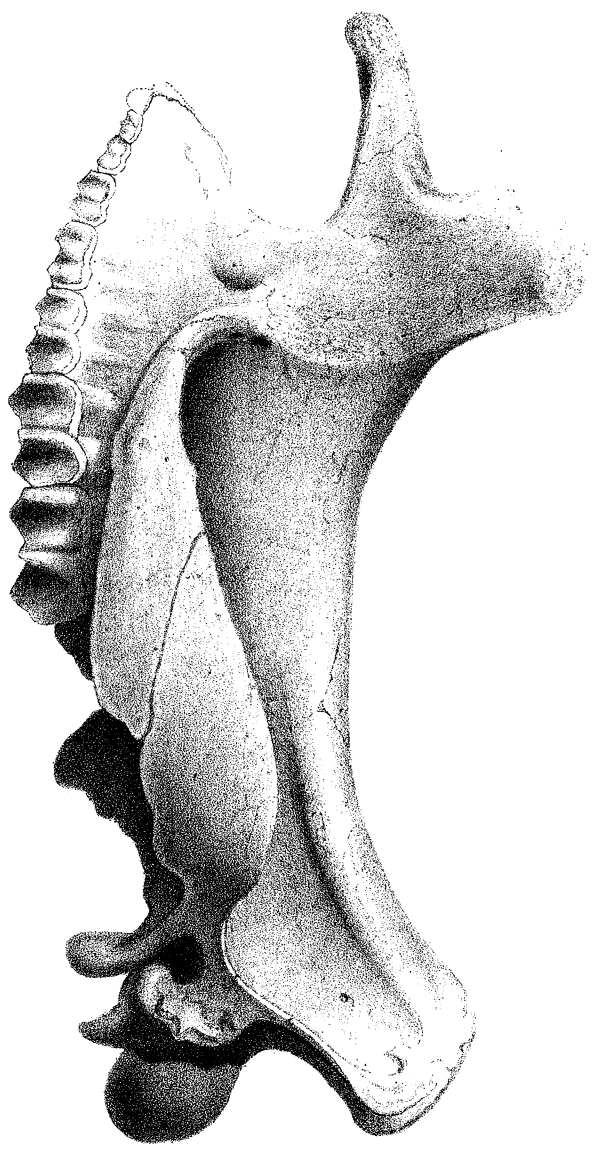
cipital process of the squamosal is elongate, and its anterior face concave. The post-glenoid process is very large, much extended transversely, and is longer than the paroccipital process.

The premaxillaries in this cranium are imperfect, and the incisors wanting. The canines, also, are not entire, but they were only of moderate size, and in close proximity to the first premolar. This tooth had two fangs, and resembled the other premolars. All of these have a strong inner basal ridge. The crowns are more nearly square than in *Titanotherium Proutii* Leidy. The upper true molars are very large, the last especially so. It resembles the corresponding tooth in *T. Proutii*, but the inner posterior angle of the crown is much more developed.

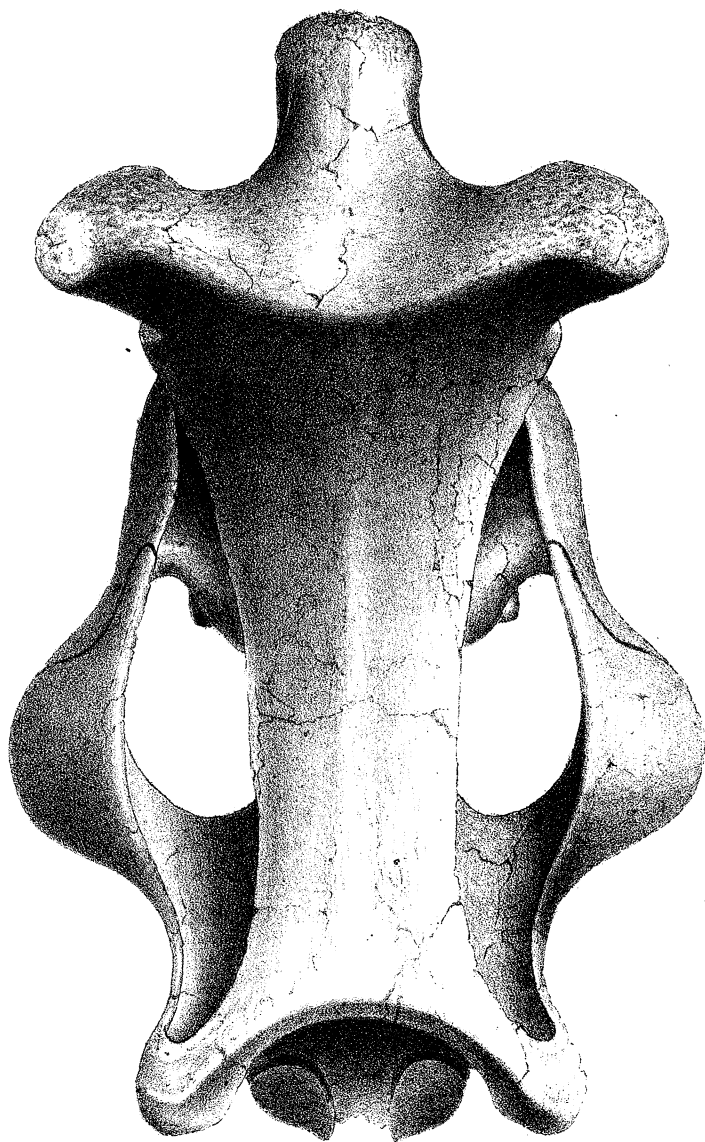
The limbs in this species were shorter than those in the existing elephants, which, in form of body, it doubtless resembled. The huge divergent horns, and the absence of tusks, gave the head a very different appearance. The wide narial opening, the rugose extremities of the nasals, and the very large infra-orbital foramen, naturally suggest that there must have been an elongated, flexible nose, possibly as extensive as in the tapir. That there was no long proboscis, as in the elephant, is indicated with equal certainty by the length of the head and neck, which renders such an organ unnecessary.

This species bears some resemblance to *Brontotherium trigonoceras* (*Symbolodon trigonoceras* Cope), but differs widely in size, having been nearly or quite twice as large in bulk. The horn-cores also, are very differently placed; the nasals are more elongated, and not emarginate at their extremities; the premaxillaries are not prominent; the squamosals are greatly expanded; and there is no post-orbital process.

In comparing the *Brontotheridæ* with the equally gigantic *Dinocerata* of the Eocene, several striking points of resemblance will be at once noticed: especially the presence of horns in transverse pairs; the general structure of the limbs and feet; and particularly the short and thick toes. The differences, however, between these two groups are still more marked. In the *Brontotheridæ* there is but a single pair of horn-cores, and no crest around the vertex. The structure and number of the teeth are quite different, while the small canines and huge molars contrast strongly with the elongated canine tusks, and diminutive molars of the *Dinocerata*. The latter, moreover, have two very large dependent







Drawn from nature by E. Cresson.

BRONTOTHERIUM INCENS, Marsh.

Indicated by small "x" on page 10.

processes on each ramus of the mandible; the cervical vertebræ flat; the femur without a third trochanter; and an additional toe in each foot.

Among the features which this group shares with the *Proboscidea* may be mentioned: the superior extension of the condylar ridge of the humerus; the short thick toes; and the late union of the epiphyses with the centra of the vertebræ. The last character appears to belong especially to mammals of very large size, and probably indicates late maturity, and great longevity.

The preceding description makes it evident that the *Brontotheridæ* constitute a very distinct family of the *Perissodactyla*. While retaining some prominent features of their Eocene predecessors, the *Dinocerata*, they are more nearly related to the Rhinoceros family, and at the same time they have some characters allying them to the *Proboscidea*, which replace them in the succeeding, Pliocene period.

All the known remains of the *Brontotheridæ* are from east of the Rocky Mountains, in the Miocene beds of Dakota, Nebraska, Wyoming and Colorado. The specimens here described are mainly from localities in the "Bad Lands" of Colorado, which were discovered and explored by the writer in the summer of 1870.\*

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#### EXPLANATION OF PLATES.

- Plate i. *Brontotherium ingens* Marsh. Side view. One-sixth natural size.  
 Plate ii. *Brontotherium ingens* Marsh. Top view. One-sixth natural size.

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## ORNITHOLOGICAL NOTES FROM THE SOUTH.

BY C. HART MERRIAM.

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### II. FLORIDA.

As I was in Florida but a few days and travelling most of the time, few opportunities were afforded for taking satisfactory notes relative to the breeding habits, etc., of many of the birds observed there. The route followed was up the St. John's river to Palatka and thence up its largest tributary, the Ocklawaha river, for a

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\* Amer. Jour. Sci. vol. i, p. 292, Sept., 1870.